THE WEATHER AND CIRCULATION OF NOVEMBER 1963

A Warm Month With Drought-Breaking Rains in the East

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1. HIGHLIGHTS

Persistence of the warm temperature regime from October [1] to November was the outstanding feature of the month. Only 4 of 100 nearly evenly spaced stations across the Nation experienced a temperature change of more than 1 class (out of 4 possible), and these 4 reported only a 2-class change. In general, the changes that occurred were in the direction of moderating the extreme warmth. As in October, the only sections with below normal temperatures were in California and the extreme Southeast. The precipitation pattern was not so persistent, as heavy rains fell in large sections of eastern United States in November where drought conditions had prevailed during October.

2. MEAN CIRCULATION

The mid-tropospheric circulation for November (fig. 1) featured a ridge very near the normal position along the Rocky Mountains [2], but the amplitude of this ridge was attenuated as seen by the negative 700-mb. height anomalies (fig. 2) over western Canada and northwestern United States. A deep trough, east of its normal position, prevailed along the Atlantic Coast of the United States and extended northwestward to Hudson Bay. The Canadian portion of this trough was weak and its negative tilt was associated with a strong blocking ridge over the Davis Strait, where a deep Low is usually found.

Over the Atlantic 700-mb. heights were mostly below normal. An intense trough extended from a low center south of Iceland to the Canary Islands off the coast of North Africa, while a ridge over mid-ocean was quite weak. The largest negative height anomaly in the Atlantic (480 ft.) was west of Ireland.

The Polar region was dominated by a deep Low near Novaya Zemlya which was more than 300 ft. below normal and located about 30° of longitude west of the expected November position. Below normal 700-mb. heights over most of Eurasia were associated with a trough extending southward to the Caspian Sea from this Arctic Low, a deeper than normal trough along the eastern coast of Asia, and the deep eastern Atlantic trough. The exceptions to this pattern of negative height anomaly were a ridge with a small positive anomaly southwest of Lake Baikal, a weaker than usual trough over the Mediterranean Sea, and a strong ridge over extreme eastern Siberia and the Bering Sea.

In contrast to the pattern over the Atlantic Ocean and Eurasia, 700-mb. heights were above normal over most of the Pacific Ocean. The only negative height anomaly in the Pacific area was situated in the Gulf of Alaska with an intensity of 340 feet. The Low center associated with this large anomaly is ordinarily over the Bering Sea, where this November a strong ridge was observed.

Figure 3 illustrates that the main core of westerlies at 700 mb. was very close to its usual latitude over most of the Pacific, eastern United States, and the western Atlantic. However, across the eastern Atlantic, Europe, and the western part of North America, the jet core was south of its normal position. This reduced amplitude of the mid-latitude jet stream favored repeated incursions of mild Pacific air masses into the United States, as is implied by the zonal index which was slightly above normal in November. At higher latitudes, the upper-level flow showed quite a different character, especially over and near North America. Strong blocking ridges mentioned earlier over both the Davis Strait and the Bering Sea resulted in large-amplitude flow and a much below normal polar westerly index for most of the month over the western part of the hemisphere (fig. 4).

3. AVERAGE MONTHLY WEATHER

TEMPERATURE

Monthly mean temperatures averaged above normal over most of the United States during November (fig. 5) except in much of California and a small part of Florida, Georgia, and Alabama where departures were slightly below normal. The November warmth was not as great as the warmth of October; maximum temperature departures were about 4° F. less. Yet, a comparison of the temperature anomalies in figure 5 with those for October (fig. 1 of [1]) reveals a strong similarity in both pattern and intensity. None of the station climatological reports examined indicated monthly temperature records

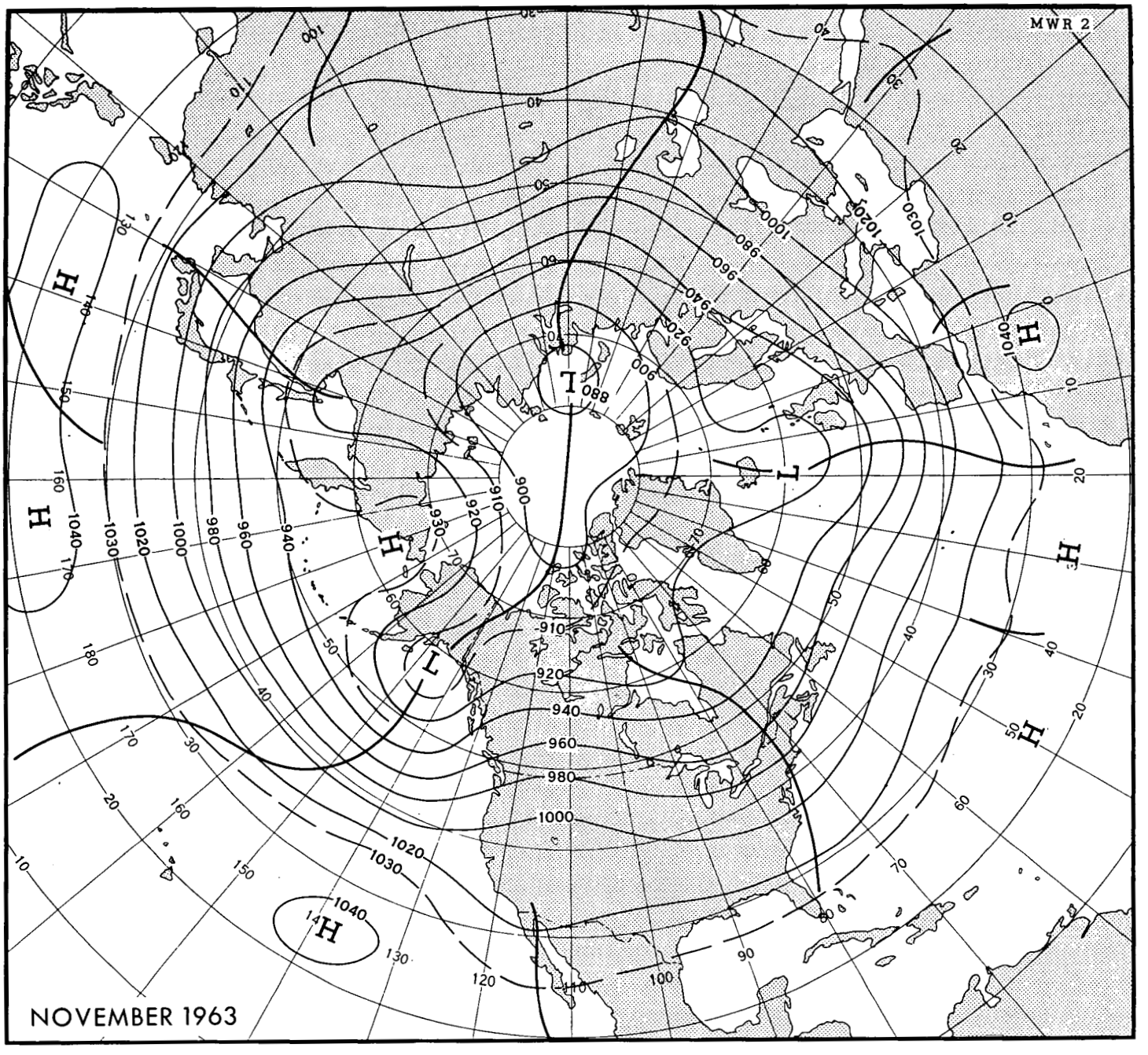

FIGURE 1.—Mean 700-mb. contours (in tens of feet) for November 1963.

had been established, although reports such as "4th warmest" were common. Several stations reported that the maximum temperature was higher than experienced before on the particular day. International Falls, Minn., for example, reported unprecedented high temperatures on November 4, 5, 8, 9, 18, and 20, and Green Bay, Wis., reported a daily record maximum of 59° F. on the 22d. Although most reports indicated that much of the United States had quite warm weather, similar warm Novembers have been observed before.

Temperatures for 39 stations fairly evenly distributed over the United States computed from Klein's [3] statistical equations, which specify the surface temperatures from the 700-mb. height pattern, were very similar to those indicated in figure 5 for the same stations. Thus, in general, the observed surface temperature was well related to the upper-level flow pattern over the United States. The only temperatures derived from Klein's specification equations that differed significantly from the observed November values were slightly below normal temperatures computed for Big Springs, Dallas, and Houston, Tex.

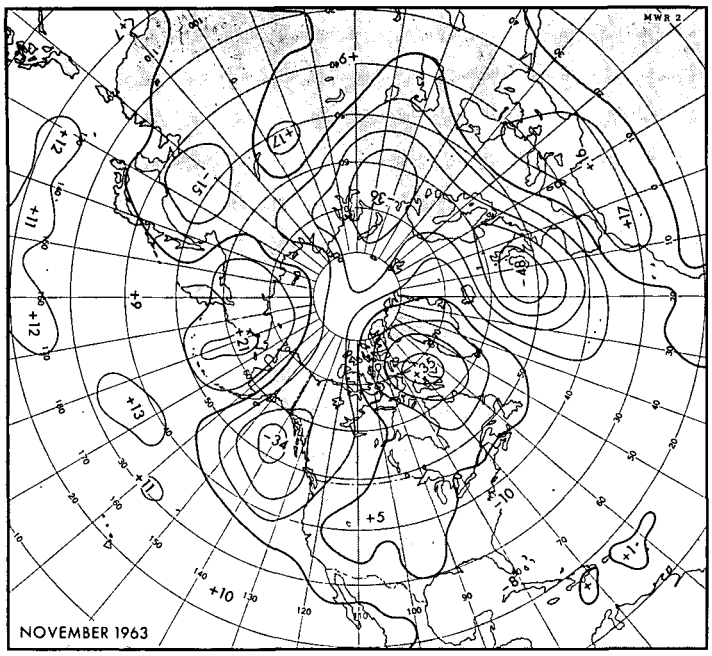

FIGURE 2.—Mean 700-mb. height departure from normal (in tens of feet) for November 1963.

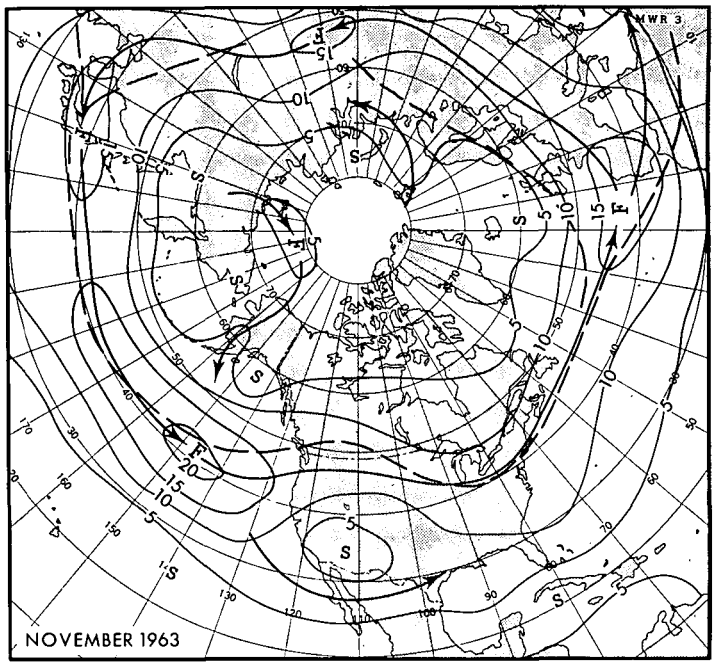

FIGURE 3.—Mean 700-mb. isotachs in meters per second for November 1963. The heavy solid arrows indicate observed axes of maximum wind speed, while dashed lines show the normal axes for November.

PRECIPITATION

The mean trough observed along the east coast was reflected in the abrupt change from the drought conditions of October in most eastern states. Rains on November 1 ended the longest recorded period of consecutive days without measurable rainfall at Columbus, Ohio (48), Washington, D.C. (32), Knoxville, Tenn. (32), and Albany, N.Y. (23). Details of the storms which brought this much-needed rain will be discussed in the next section. Several stations which had little or no rainfall in October, received record amounts in November, such as 8.58 in. at New Haven, Conn., 7.98 in. at Daytona Beach, Fla., 7.74 in. at Caribou, Maine. Washington, D.C., and New York, N.Y. received the heaviest November rainfall since 1877 and 1889 respectively. In Washington, this followed the first rainless (no measurable amount) month of record.

Stronger than normal southwesterly flow and below normal heights (figs. 1, 2) contributed to continued heavy rains in the Far West (fig. 6). At the same time the anomalous southwesterly flow over the Rocky Mountains from Wyoming northward intensified the "rain shadow" giving less than half the normal rainfall for most of Montana and Wyoming. Precipitation also continued generally deficient in most of the area from the Great Plains to the Appalachians as northwesterly flow aloft persisted. Heavy precipitation in Texas was associated with confluence of the flow from the low-latitude trough in the Southwest and the main westerlies to the north. Variation of the precipitation pattern elsewhere can best be explained by examining the half-month circulation patterns under the next section.

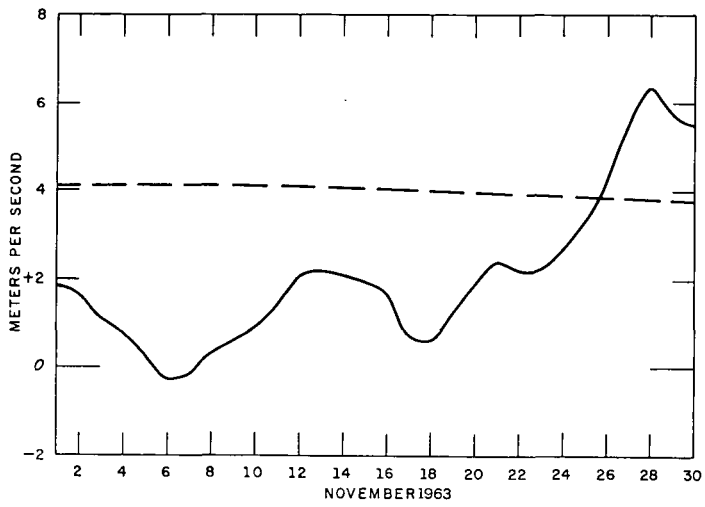

FIGURE 4.—Time variations of the speed of 700-mb. polar westerlies averaged over the western half of the Northern Hemisphere between 55° and 70° N. Solid line connects 5-day mean index values computed for each day of the month, while dashed line gives the corresponding normal.

4. INTRA-MONTHLY VARIATIONS IN WEATHER AND CIRCULATION

NOVEMBER 1–15

Rather sudden and important changes occurred in the upper-level circulation at the very beginning of November. A deep trough with large negative height anomalies developed along the east coast of the United States. This deep trough then persisted for the first half of the month

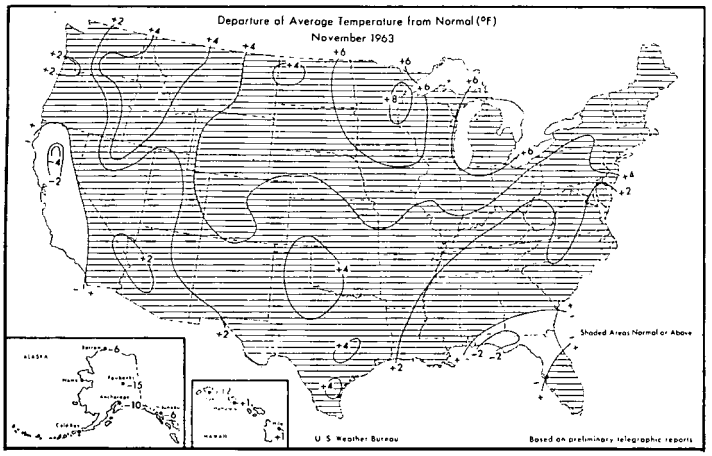

FIGURE 5.—Departure of the average surface temperature from normal for November 1963 (from [6]).

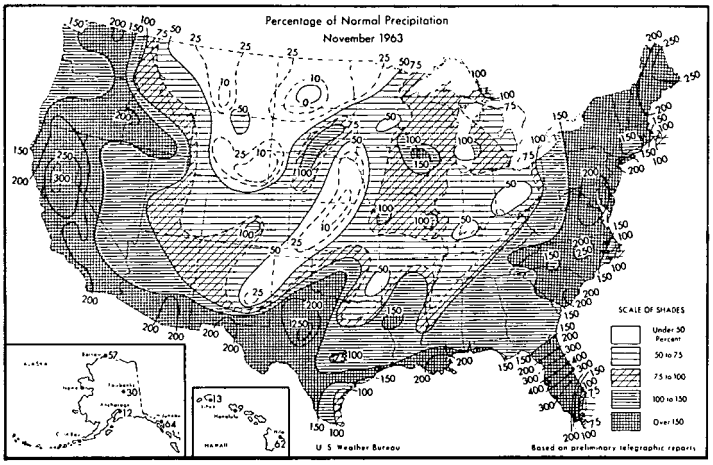

FIGURE 6.—Percentage of normal precipitation for November 1963 (from [6]).

with the 15-day mean, 700-mb. contours (fig. 7A) looking very much like the first 5-day mean pattern of November over the United States. Three major surface storms, spaced 4 to 7 days apart, developed in this trough. Cool air surges following these storms resulted in a large area of below normal temperature in the East (fig. 7B) during the first half of the month. Each storm released large amounts of precipitation (fig. 7C) that produced record 24-hour amounts for November at some stations. Other elements besides precipitation indicated the intensity and persistence of the storminess in eastern United States during the first half of the month. Hartford, Conn, and Concord, N.H., for example, reported the lowest November atmospheric pressure of record, while Allentown, Pa., registered the lowest pressure for any month. Milton, Mass., had the least sunshine of record for November, and examination of the daily sunshine amounts revealed that the shortage occurred during the first half of the month.

Under and immediately to the east of the mean ridge (fig. 7A) over western North America, precipitation was light and temperatures were above normal. Offshore storminess connected with the deep Low in the Gulf of Alaska and the resulting strong southwesterly upper-level

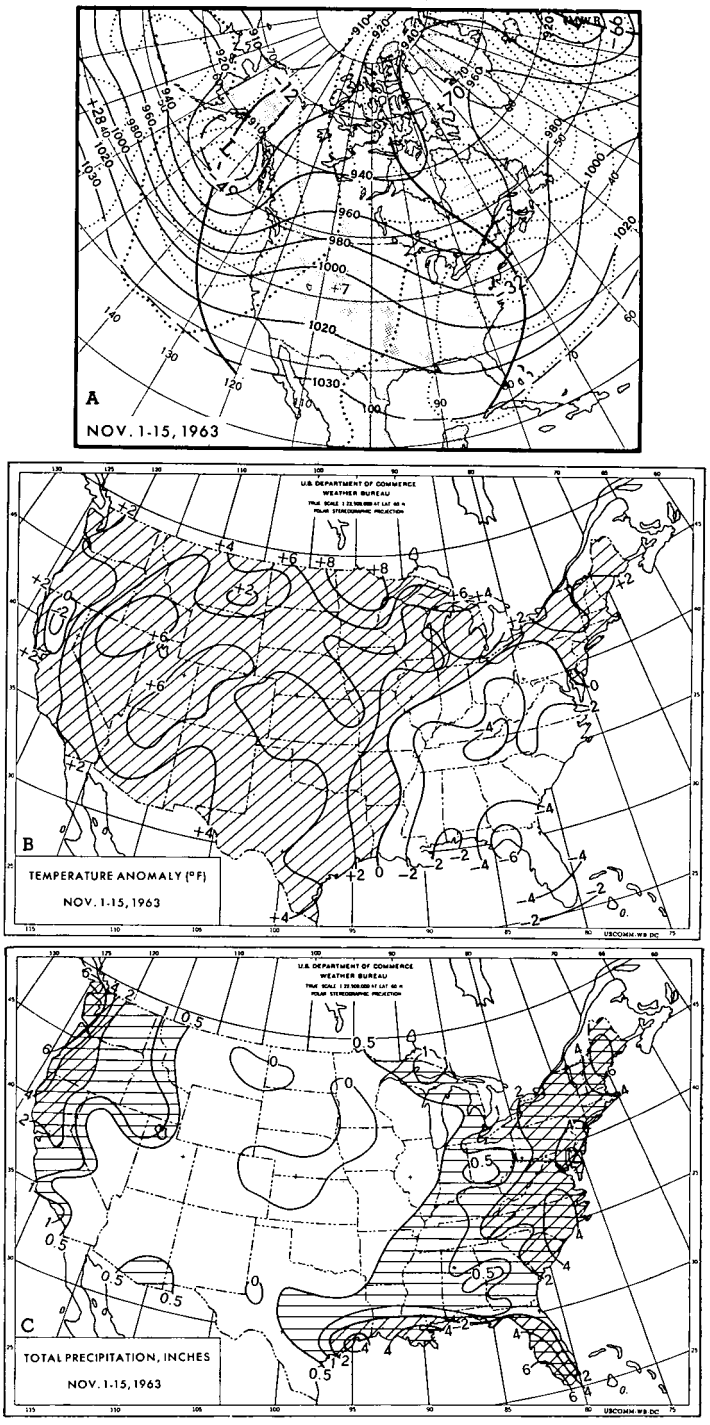

FIGURE 7.—(A) 700-mb. height and departure from normal (both in tens of feet), (B) surface temperature departure from normal (above normal hatched), and (C) total precipitation (less than 0.5 in. unshaded, 0.5 to 2 in. hatched, more than 2 in. crosshatched) all for November 1–15, 1963.

flow gave heavy precipitation along much of the west coast. Abnormally persistent cloudiness seems to have been the major factor in the small area of below normal temperature in northern California. Red Bluff, Calif., reported completely overcast skies for 9 days in the first half of the month and 2 more days with an average cloudiness of 9/10.

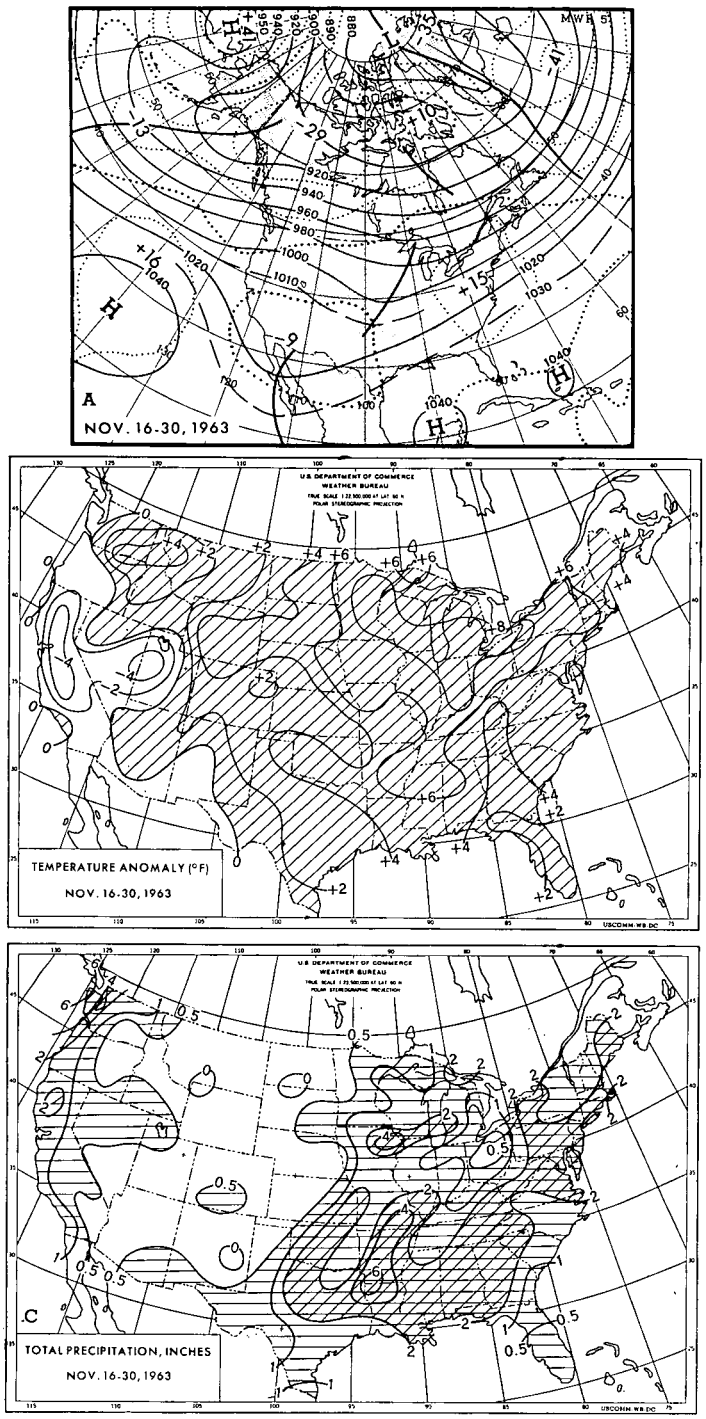

FIGURE 8.—(A) 700-mb. height and departure from normal; (B) surface temperature departure from normal (above normal hatched), and (C) total precipitation (less than 0.5 in. unshaded, 0.5 to 2 in. hatched, more than 2 inches crosshatched) all for November 16-30. 1963.

NOVEMBER 16–30

During the last half of November (fig. 8A) the mean trough over the United States was in the central part of the country and had much less amplitude than did the trough along the east coast earlier in the month. A major portion of the United States was subject to anomalous flow with southerly components at 700 mb. resulting in above normal temperatures for the eastern two-thirds of the country and most of the Northwest (fig. 8B). Most of the cool weather in the Southwest was associated with below normal 700-mb. heights and easterly anomalous flow.

Confluence to the east of the sheared low-latitude trough over Baja California was accompanied by heavy rainfall (fig. 8C) during the last half of the month in parts of Texas and neighboring States. The mean trough from Oklahoma northeastward across Wisconsin was responsible for the heavy rain in eastern Iowa, northern Illinois, southern Wisconsin, and parts of Michigan. Large rainfall amounts shown in figure 8C for East Coast States occurred late in the month as the long-wave trough again moved eastward, associated with a deep surface storm that was located in the Northeast on the last day of the month. Retrogression of the eastern Pacific trough during the last half of November reduced the amount and extent of west coast precipitation. Relative dryness persisted over most of the Northern Plains and Rocky Mountains in connection with the mean ridge northward from the Nevada-Utah area.

One very interesting dry area which is rather difficult to explain was observed during the latter part of November in Ohio. Reference to figures 7C and 8C shows that this dryness persisted all month with some larger amounts of precipitation occurring on all sides, especially so during the last half of November. Perhaps the key is found in such reports as the 15.4 in. annual precipitation deficit at Cleveland, Ohio. O'Connor [4] referred to 8 months of drought at Cleveland in discussing the August weather. Remarks in the monthly report from Columbus, Ohio, stated "Rainfall frequency equal to long term average." but added "Total precipitation September, October, November 20% of normal. Drought continued." All of these reports from Ohio lend credibility to the feed-back mechanisms so often stressed by Namias [5].

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